Advanced Smart Munitions

- *a designer's perspective*

  - **New Missions**
  - **New Challenges**
  - **New Solutions**

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Aerojet

The Evolving Battlefield

- **Fluidity -**
  - Rapid force movements by friend and foe alike
- **Digitization**
  - Improved surveillance and communications and situational awareness
- **More Urbanized Terrain**
  - Impediment to movement and sensors
  - Combatants mixed with non-combatants
- **Increased Fire Support Delivery Range And Accuracy**
  - Gliding projectiles, guided rockets and ballistic missiles, cruise missiles
- **Diversified Target Arrays**
  - Trend towards greater dispersion / lower density
  - Mixed target element types (high and low value) in same area

Diversified Targets In Complex Scenarios

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Counterfire

- Small, mobile artillery units: towed, SPH's, MRL's, mixed with support vehicles

Interdiction

- Armored columns on road or cross country march
- Assembly areas with tanks, SPH's, trucks

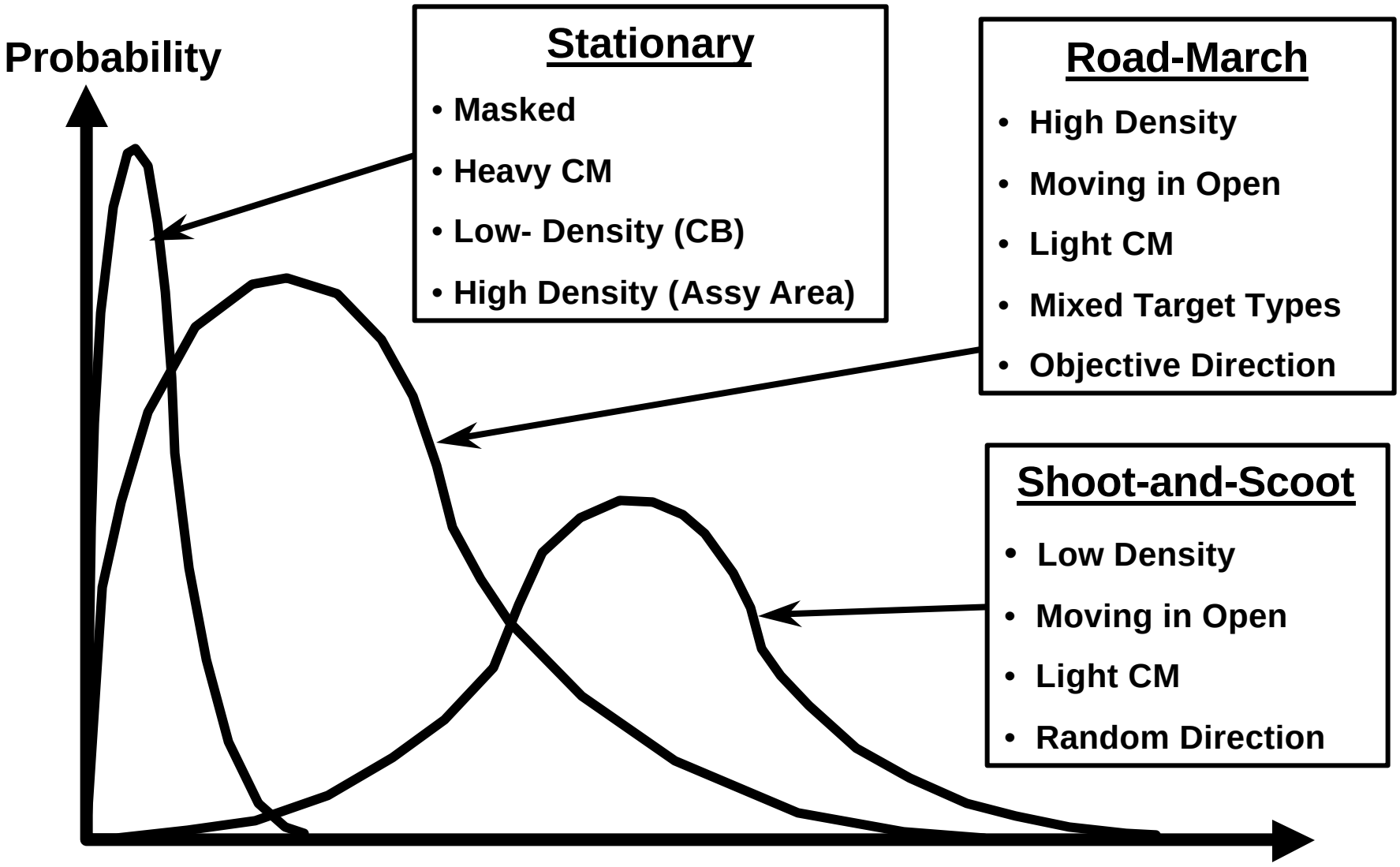
High Value / Low Density

- SRBM/MRBM TEL
- Air defense units

Target Tactics

- Frequent maneuvering -- "Shoot & Scoot"
- When stationary -- emplaced in treelines, under nets, with decoys
- Exploit urbanized terrain for masking and protection whenever possible
- Proximity to noncombatants

Scenarios Drive Smart Submunition Required Sensor Footprint And Signature Complexity



Smart Submunition Key Impact Is On The Sensor

- **Flexible Target Acquisition Footprint (Sensor Detection Range)**
  - **Maneuvering target sets at depth**
  - **Initial target acquisition errors**
  - **C^3I delays**
  - **Submunition carrier flyout delays**
  - **Collateral damage considerations**
- **Improved Target Detection (Sensor Use Of Scenario Context)**
  - **Targets in urban clutter**
- **Target Classification**
  - **Attack high value targets preferentially in mixed target scenarios**
  - **Collateral damage considerations**
  - **Bias warhead aimpoint to a target-specific center-of-vulnerability and control warhead pattern**

Available Sensor Technologies

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- **Imaging LADAR**

  limited all-weather capability, good target classification, potentially good detector of targets in urban environments

- **MMW**

  all-weather, increased detection range capable, limited target classification capability

- **Imaging IR**

  moderate all-weather capability, moderate target classification

- **Imaging Visible**

  low cost, requires nocturnal illuminators, limited by weather

- **Acoustic**

  all-weather, susceptible to decoys, ineffective against targets with engines shut down, requires a “quiet” submunition

- **Magnetic**

  limited footprint, limited sensitivity against aluminum-hulled targets

MMW Sensor Technologies Aim At Improved Target-To-Clutter Ratio At Extended Ranges

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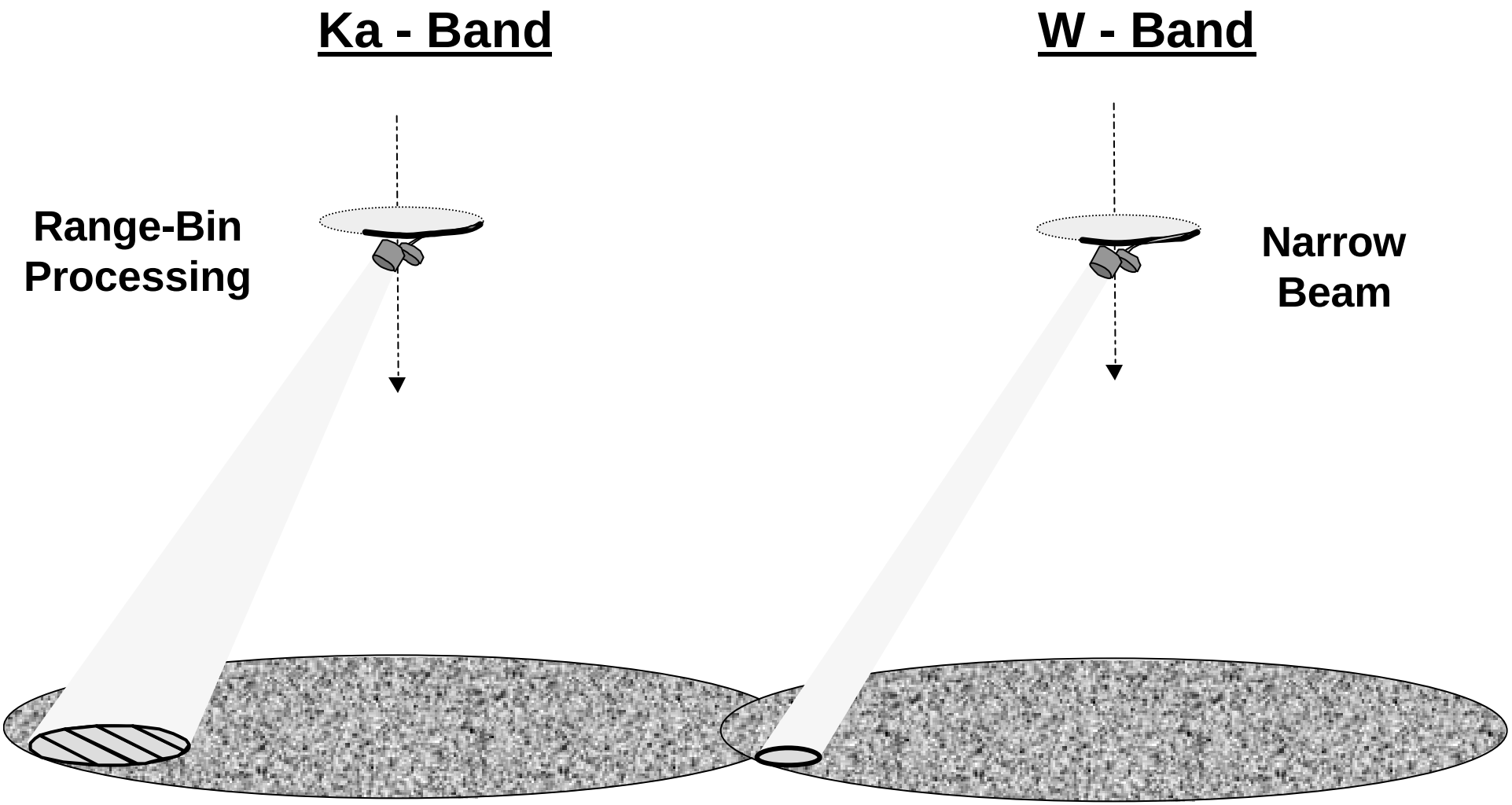

IR-LADAR Imagery Fusion Demonstrates The Value Of A Multi-EO-Sensor Approach

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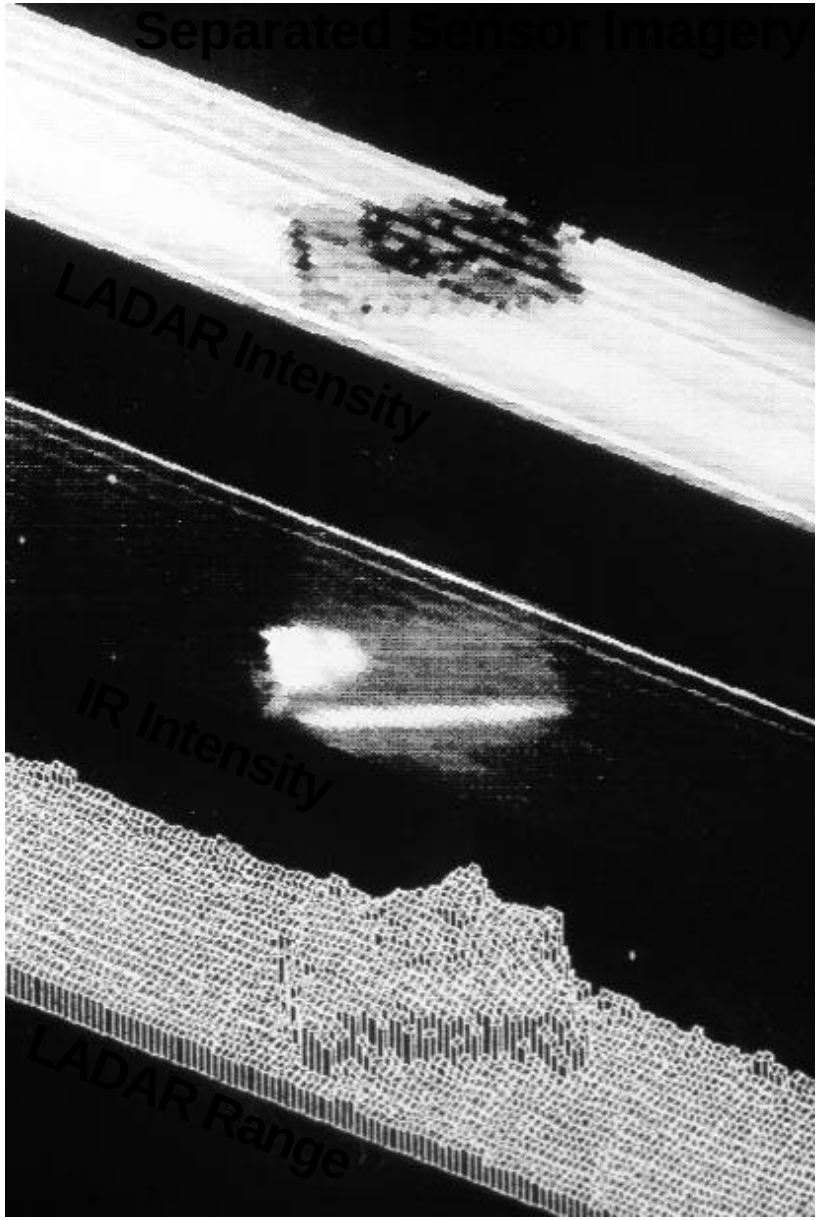

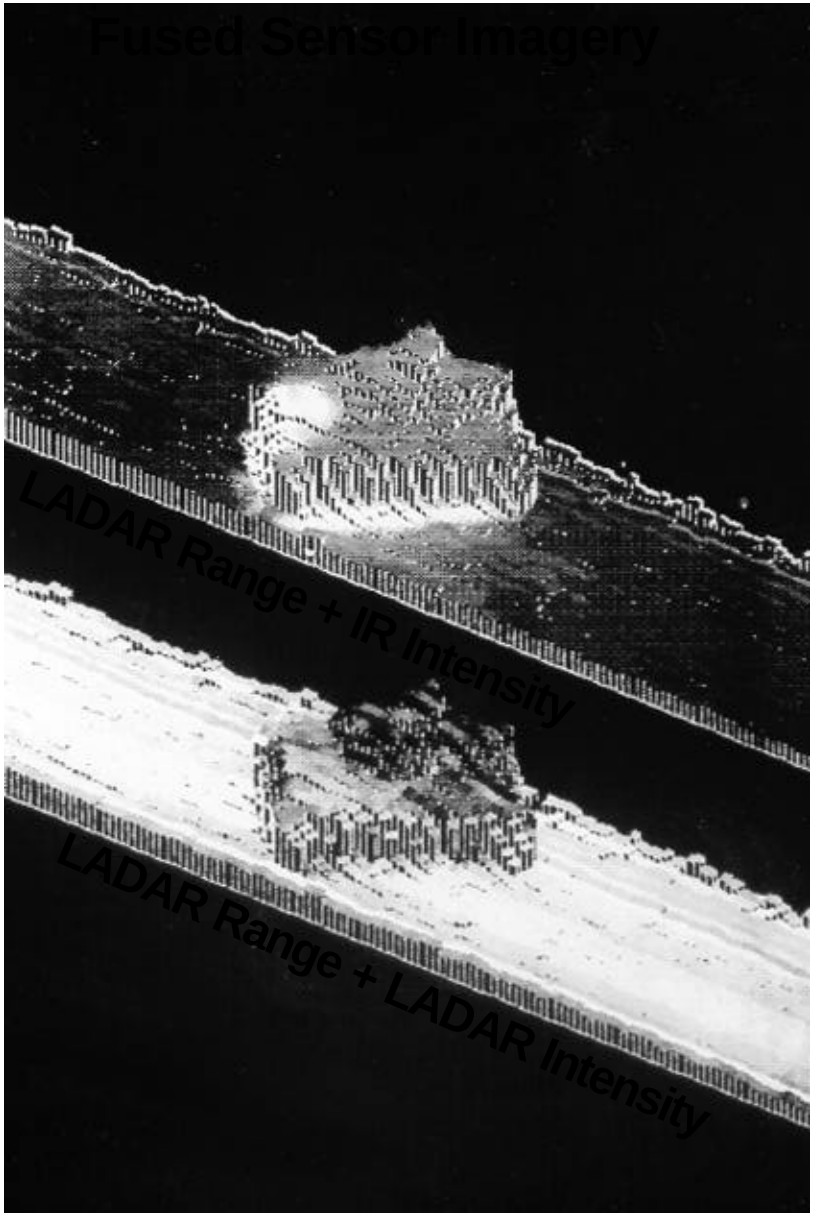

Fused IR-LADAR Sensors Enable Target Detection And Classification In Heavy Clutter

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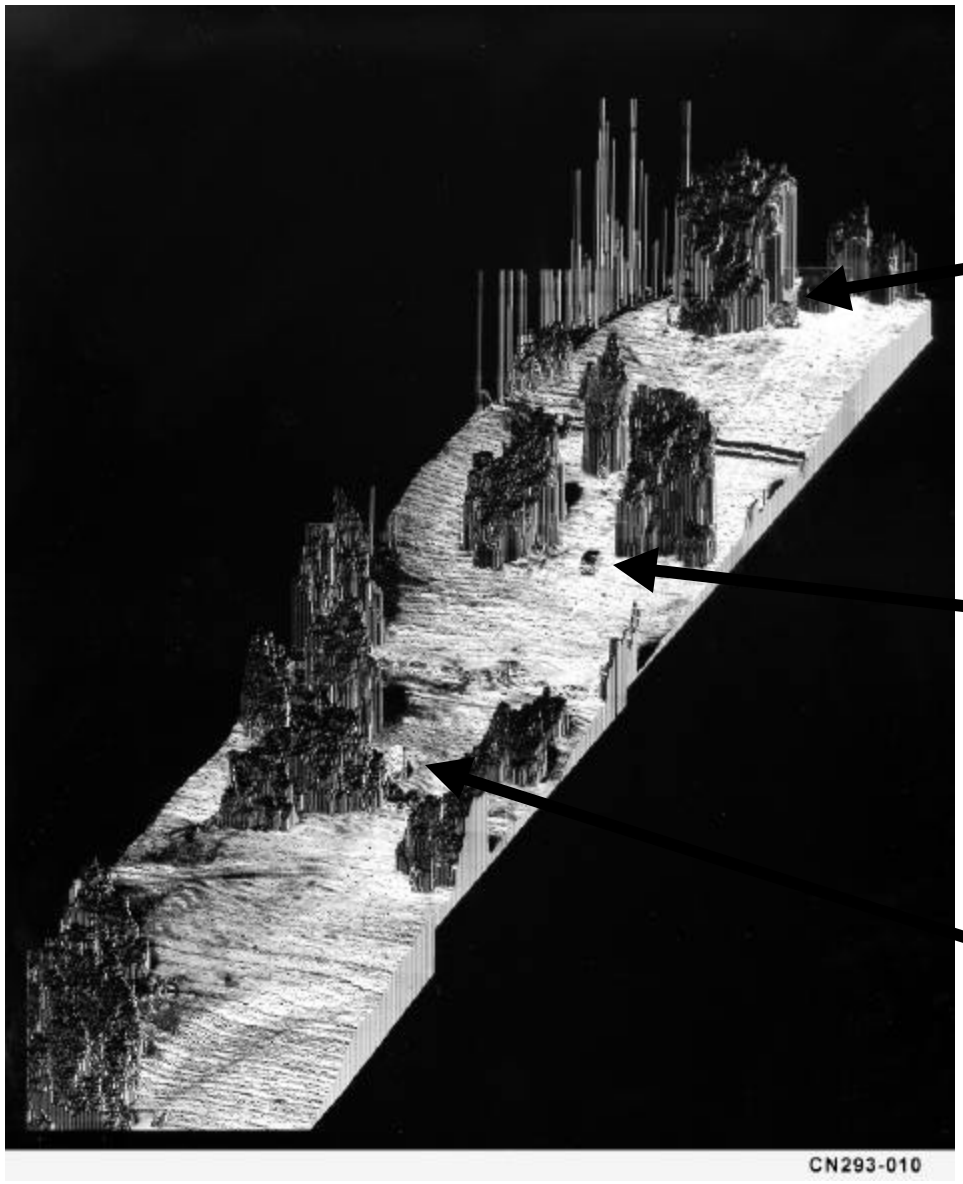
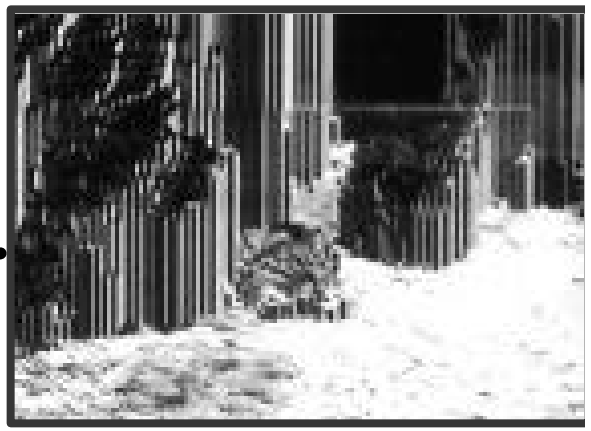
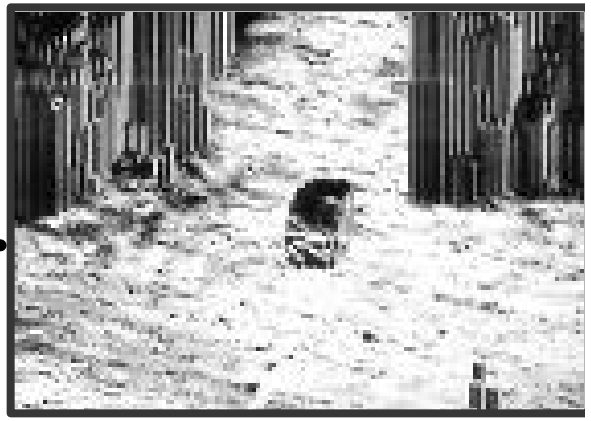


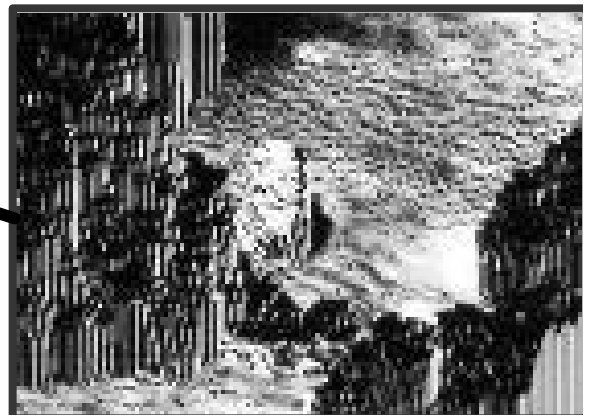
Tank

APC

Truck







Summary

- **Evolving missions for smart munitions create technological challenges for sensors**
  - **Tailored footprint and detection range.**
  - **Target classification.**
- **Aerojet is meeting these challenges by ongoing work in:**
  - **MMW radars with range binning and higher operating frequencies.**
  - **Combined LADAR-IR imaging sensors.**
  - **Advanced signal processing.**